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ABSTRACT

This study compared the effects of several presentation sequences on lesson performance to determine whether sequence has a significant effect on performance in computer-based instruction, and whether using the same sequence consistently is more effective than not being consistent. Thirty-six students from the Basic Electricity and Electronics School, Service School Command, San Diego, were randomly assigned to one of four groups differing by the instructional presentation sequence used. The first group saw lessons in a rule-examples-practice sequence; the second, in an examples-rule-practice sequence; the third, in a practice-examples-rule sequence; and the fourth, in a random sequence. The lesson materials were three computer-based instruction lessons delivered via PLATO IV terminals, one on voltage in series circuits, and one each on using the Simpson Model 260-5P multimeter as an ammeter and as a voltmeter. There were no consistent differences in performance among the four groups during the three lessons. Conclusions and recommendations for further study of instructional sequencing are outlined. (Author/RAO)

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THE EFFECT OF INSTRUCTIONAL PRESENTATION SEQUENCE ON STUDENT PERFORMANCE IN COMPUTER-BASED INSTRUCTION

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Performance data were collected to compare the effects of four different methods of sequencing instructional presentations. Lessons prepared in a "rule, examples, practice" format were presented in either a rule-examples-practice, examples-rule-practice, practice-examples-rule, or random presentation sequence. The time to complete the lessons, total number of responses, post-lesson test scores, and percentage correct on practice problems of medium difficulty were compared for the

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four groups. The results indicate that the different presentation sequences have no significant effect on overall performance.

FOREWORD

This research and development was performed in support of Navy Decision Coordinating Paper: Education and Training Development (NDCP: Z0108PN), under subproject PN.30A: Adaptive Experimental Approach to Instructional Design. The objective of this subproject is to establish empirical bases for selecting instructional and evaluative procedures for Navy training courses. The study revealed that the learner control mode can be used in computer-based instruction without detriment to student performance.

The data are directed to researchers interested in applying computer-based instruction for training. They may be of particular interest to current users at North Island Naval Air Station, San Diego, CA (S3A Training), the Naval Guided Missiles School, Dam Neck, VA , and the Navy Fleet Ballistic Missile Submarine Training Center, Charleston, SC.

The contributions of Dr. William A. King , who helped to monitor students during this project, and Ms. Betty Whitehill, who helped to gather data, are appreciated. Thanks are also due to the personnel of the Basic Electricity/Electronics School, Service School Command, Naval Training Center (NTC), San Diego, who participated in the project.

DONALD F. PARKER
Commanding Officer

SUMMARY

Problem

Research data have not established the effects of instructional presentation sequence on performance in computer-based instruction (CBI). Data are needed to determine whether the learner control mode of CBI, wherein presentation sequences may vary, is as effective in CBI programs as a programmed control mode.

Purpose

This study compared the effects of several presentation sequences on lesson performance to determine whether sequence has a significant effect on performance, and whether using the same sequence consistently is more effective than not being consistent.

Approach

Thirty-six students from the Basic Electricity and Electronics School, Service School Command, San Diego, were randomly assigned to one of four groups differing by the instructional presentation sequence used. The first group saw lessons in a rule-examples-practice sequence (RU-EG-PR Group); the second, in an examples-rule-practice sequence (EG-RU-PR Group); the third, in a practice-examples-rule sequence (PR-EG-RU Group); and the fourth, in a random sequence (RANDOM Group). The lesson materials were three CBI lessons delivered via PLATO IV terminals, one on voltage in series circuits, and one each on using the Simpson Model 260-5P multimeter as an ammeter and as a voltmeter.

Results

There were no consistent differences in performance among the four groups during the three lessons. The RANDOM Group appeared to be superior in the first (Amps) lesson on the major measures--time, number of responses, and test score--but this superiority did not continue in the other two lessons. An expected superiority for the RU-EG-PR Group (Lahey & Coady, 1978) did not materialize.

Conclusions and Recommendations

Different presentation sequences had little effect on overall lesson performance. Instructional sequences selected by the learner therefore are be expected to be as effective as those selected by the lesson designer. Further investigation of learner control of presentation sequence in CBI is therefore warranted to explore its motivational and economic advantages. Additional work should have the following objectives:

1. The results of this study should be confirmed with other course materials and other student populations.

2. Interactions should be investigated between presentation mode and learner characteristics such as internal-external locus of control.

3. The effect of learner control of lesson strategy on learning to learn and teacher independence, as postulated by Merrill (1973), should be studied longitudinally.

4. The possible cost economies pertaining to use of the learner control lesson structure should be investigated.

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INTRODUCTION

Problem

Research data have not established the effects of instructional presentation sequence on performance in computer-based instruction (CBI). Data are needed to decide whether the learner control mode of CBI, wherein instructional presentation sequences vary, is as effective in CBI programs as programmed control.

Background

In the learner control mode of CBI recommended by Merrill (1973), lesson content consists of rules, examples, and practice problems for each objective in the lesson, collected in lesson segments. Each lesson segment is devoted to a specific learning objective. The student is free to do the segments in any order, and to take the rules, examples, and practice problems in any sequence (see Lahey, Crawford, & Hurlock, 1976). The sequence the student selects, exclusive of repetitions, defines the lesson strategy. For example, a sequence of rule-example-rule-practice-example-rule would be identified as a rule-example-practice strategy. Using this definition, six basic instructional strategies can be defined: rule-examples-practice, rule-practice-examples, examples-rule-practice, examples-practice-rule, practice-rule-examples, and practice-examples-rule.

Lahey and Coady (1978) compared the performance of students given control of lesson strategy in a series of four computer-based lessons to that of students studying under programmed control. The results did not demonstrate motivational or pedagogical advantages for the learner control mode. As in previous research (Lahey & Crawford, 1976), the results showed that most of the students given learner control chose to use a rule-example-practice strategy. It appeared that this strategy might be instructionally superior, since students who used it made higher scores; but there were not enough data for a conclusive analysis. One of the recommendations of the study was the gathering of more data to compare the effects of different strategies. Establishing the superiority of one strategy over the others would raise doubts about the need for learner control, since the superior strategy could be incorporated into an adaptive programmed control mode.

Another question left unanswered by the 1978 study was whether using one strategy consistently is pedagogically superior to using several. Merrill (1973, 1975) advocated the use of learner control on the grounds that it would teach students to learn and make them independent of the teacher. He presumed that students would try different strategies, then select the one that worked best. Lahey and Crawford (1976) and Lahey and Coady (1978) found no indication that students compare alternate strategies. Students usually adopted a strategy early in their experience and used it more or less consistently. Campbell and Chapman (1967), studying the performance of elementary students given learner control in the classroom, also noticed this tendency. If students tend to be satisfied with a strategy without determining that it is superior to other strategies, Merrill's premise that giving students control of the presentation sequence will optimize their performance is questionable. One way to evaluate the effect of selecting a less than optimal strategy is to deliver strategies randomly and compare student performance to that recorded when a single strategy is used consistently.

Purpose

This study compared the effects of three fixed strategies and a random presentation sequence on student performance. The purpose was to answer the following questions:

1. Does lesson strategy have a significant effect on student performance?

2. Is a consistent lesson strategy more effective than no consistent strategy?

METHOD

Design

The experimental design included four experimental groups studying three computer-based instruction (CBI) lessons. Each group used one of four preprogrammed lesson strategies: rule-examples-practice (RU-EG-PR), examples-rule-practice (EG-RU-PR), practice-examples-rule (PR-EG-RU), or a random sequence (RANDOM). Lesson performance data were compared using a one-way ANOVA with planned comparisons based on the following assumptions: (1) seeing the rule first would facilitate recognition of essential attributes in examples and practice, (2) seeing the rule and examples before practice would facilitate performance during practice, (3) a fixed sequence of presentation would be superior to a random sequence.

Subjects

Fifty-two students selected from the Basic Electricity and Electronics (BE/E) School by their learning supervisors were assigned at random to the experimental groups. Five students withdrew before finishing all three lessons, and the data for eleven students were lost due to program errrors. Consequently, groups of the following sizes were available for analysis: RU-EG-PR = 9, EG-RU-PR = 9, PR-EG-RU = 8, RANDOM = 10. Data on the compatibility of the four groups as determined by Word Knowledge (WK), Arithmetic Reasoning (AR), and Electronic Information (EI) tests of the Armed Services Vocational Aptitude Battery (ASVAB) are presented in Table 1. There was no significant difference among the means on the different measures.

Table 1

Compatibility of Experimental Groups on Word Knowledge (WK), Arithmetic Reasoning (AR), and Electronic Information (EI) Tests

Item	RU-EG-PR	EG-RU-PR	PR-EG-RU	RANDOM
Individual Measures:				
Mean WK	59	60	61	57
SD	6.4	5.2	5.8	4.4
Mean AR	57	60	57	58
SD	5.3	5.6	4.7	6.3
Mean EI	60	57	59	60
SD	3.0	5.4	5.8	6.9*
Number of Students:	8	7[a]	8[b]	8[c]

*Cochran's C = 0.405, $p < .05$; one student with an EI score of 48 accounts for most of the variance.

[a]EI data available for only 5 students.

[b]EI data available for only 7 students.

[c]EI data available for only 7 students.

Experimental Period

The experimental period extended from 20 April to 30 June 1977.

Training Materials

The training materials consisted of two CBI lessons on the use of the Simpson Model 260-5P multimeter, one to measure current flow and one to measure voltage, and a short CBI lesson on voltage in series circuits. An introductory CBI lesson that preceded the training materials taught the student how to use the computer terminal.

The lessons were based on objectives and concepts identical to those in the individualized lesson booklets used by the BE/E School for the lessons that the CBI lesson replaced. The CBI lessons were used as part of the regular course of instruction, and were presented via standard PLATO IV student terminals with touch panels.

Each lesson consisted of segments devoted to specific objectives. The lesson on use of the multimeter as a DC ammeter (Amps Lesson) included 9 objectives; the lesson on voltage in series circuits (Voltage Lesson), 4 objectives; and the lesson on use of the multimeter as a voltmeter (Volts Lesson), 10 objectives. The lesson materials were identical for each group of students.

Each lesson segment consisted of rules, examples, and practice problems at easy, medium, and hard levels of difficulty, an arrangement used previously (Lahey, Crawford, & Hurlock, 1976). The level of difficulty was determined by the quantity and technical complexity of the information in the presentation form (i.e., the rule, example, or problem). Easy materials were used in one lesson segment in the Amps Lesson and two lesson segments in the Volts Lessons, and hard materials were used in three lesson segments in each of these lessons. Seventeen of the 23 lesson segments contained only medium level materials. All problems contained re-try branching and correct-incorrect answer feedback. Fill-in problems included prescriptive feedback for common errors.

Students were required to meet a criterion of approximately 80 percent in each of three post-lesson tests. Students who failed to meet criterion were allowed to choose any lesson segment they wanted and any presentation within each lesson segment for review. They then retook the test before completing the lesson. The review facility was used most often during the Amps Lessons, when it was used by five RU-EG-PR Group students, six EG-RU-PR Group students, six PR-EG-RU Group students, and one RANDOM Group student.

Experimental Treatment

The experimental groups were guided through the three lessons in order--Amps, Voltage, Volts. Within each lesson, they were guided through the lesson segments in order. Within the lesson segments, each student was guided through the presentation sequence appropriate to his group. Usually the student started at the medium level, then saw examples and practice problems at the hard level. In one segment in the Amps Lesson and two segments in the Volts Lesson, the students started at the easy level, then moved on to materials at the medium and hard levels. All training was self-paced.

The presentation sequence for individuals in the RANDOM group varied from student to student and from segment to segment. At the start of each segment, the computer randomly selected one of the three presentation forms. It then randomly chose one of the

remaining two presentation forms, and finally presented the last one. Thus, in each segment, the students in the RANDOM Group could see one of the three basic strategies or one of the other three possible strategies--rule-practice-examples, examples-practice-rule, or practice-rule-examples. The paradigm for lesson segment termination required seeing the same number of examples and practice problems as was required for students in the other groups.

The first frame within each lesson segment was the same for all students and consisted of an expanded objective statement used as an advance organizer.

Experimental Measures

Counters were used to track each student's progress through the lesson, and a data "trail" was prepared to identify each response, its latency, and the correctness of answers to questions. The data used for analysis consisted of post-lesson test scores (initial attempt only), total number of responses, time on the lesson, and the percentage of correct responses to practice problems at the medium level. Responses made during the review period, and the time taken in review and in retaking the test, were added to the student's response and time totals. Responses to a questionnaire completed on conclusion of the Volts Lesson were also analyzed.

RESULTS

Data indicating the performance of the four groups of students on all three lessons are presented in Table 2. Tests for homogeneity of variance and planned comparisons were performed for all measures. Table 2 shows that the performance data were not consistent across the three lessons nor across the four major variables.

Post-lesson test scores differed significantly among the groups in the Voltage and Volts Lessons (df = 3,31, MSW = 17.78, F = 3.09, $p < .05$; and df = 3,26, MSW = 53.92, F = 2.96, $p < .05$, respectively). In the Voltage Lesson, the performance of the PR-EG-RU Group was inferior to that of the combined RU-EG-PR and EG-RU-PR Groups (df = 1,31, MSW = 17.78, F = 2.16, $p < .05$). The performance of the RANDOM Group was also inferior to that of the RU-EG-PR and EG-RU-PR Groups. In the Volts Lesson, the performance of the EG-RU-PR Group was inferior to that of the RU-EG-PR Group (df = 1,29, MSW = 53.92, F = 2.32, $p < .05$), but the variance for this group was significantly greater than that for the other groups. No other comparisons were significant.

The response totals also differed between the three lessons. There was a significant difference in number of responses made on the Amps Lesson (df = 3,29, MSW = 2245, F = 4.75, $p < .01$). There were no significant differences on the Voltage or Volts Lessons. In the Amps Lesson, the PR-EG-RU Group made significantly more responses than did the other groups. Again, however, the variance for the deviant group is significantly greater than that for the other groups. The comparison with the combined RU-EG-PR and EG-RU-PR Groups was significant (df = 1,29, MSW = 2245, F = 2.91, $p < .01$). The planned comparison of the fixed-sequence groups to the RANDOM Group was also significant (df = 1,29, MSW = 2245, F = 2.37, $p < .05$), but this difference was attributable to the poor performance of the PR-EG-RU Group.

The percentages correct on medium-level practice problems differed significantly between the groups during the Amps Lesson (df = 3,29, MSW = 96.39, F = 6.08, $p < .01$). The RU-EG-PR Group had a higher percentage of correct scores on these problems than did the EG-RU-PR Group (df = 1,29, MSW = 96.39, F = 2.78, $p < .01$) or the PR-EG-RU Group (df = 1,29, MSW = 96.39, F = 14.67, $p < .01$).[1] The comparison of the combined RU-EG-PR and EG-RU-PR Groups to the PR-EG-RU Group was also significant in this lesson (df = 1,29, MSW = 96.39, F = 2.67, $p < .05$). The groups did not differ in performance as to this measure on the other two lessons, but the PR-EG-RU Group had the lowest percentage correct in all three lessons. Moreover, in the Amps and Volts Lessons, the percentage correct for the PR-EG-RU Group was lower at the easy and hard levels of difficulty as well. The difference was significant only in the Amps Lesson, at the easy level, where the means for this measure were 80.7, 71.1, 38.1, and 69.0 percent, respectively. The PR-EG-RU Group differed significantly from the combined RU-EG-PR and EG-RU-PR Groups (df = 1,30, MSW = 563.78, F = 26.82, $p < .01$).

Time on the lesson differed significantly during the Amps and Volts Lessons (df = 3,29, MSW = 1164, F = 4.61, $p < .01$; and df = 3,26, MSW = 402.6, F = 4.20, $p < .05$, respectively), but they did not differ significantly on the Voltage Lesson. In the Amps Lesson, students in the RU-EG-PR and EG-RU-PR Groups spent significantly less time on the lesson than did the PR-EG-RU Group (df = 1,29, MSW = 1164.0, F = 2.46, $p < .05$). Fixed-sequence groups spent significantly more time on this lesson than did the RANDOM

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[1] Based on Scheffe's multiple comparison procedure for unplanned comparisons.

Table 2

Lesson Performance Data

Lesson/Group	N[a]	Test Score (%)	Number of Responses	Practice-Correct[b] (%)	Lesson Time (Hours)
Amps Lesson					
RU-EG-PR	9	69.0	203	81.9[c]	2:22
EG-RU-PR	7	69.1	192	68.1	2:00
PR-EG-RU	8	72.0	257[d]	63.6	2:48[e]
RANDOM	9	80.1	173	77.2	1:50
Voltage Lesson					
RU-EG-PR	9	97.3	46	84.7	0:23
EG-RU-PR	9	95.3	44	93.2	0:23
PR-EG-RU	7	92.3[f]	50	81.1	0:26
RANDOM	10	92.2[f]	48	90.9	0:23
Volts Lesson					
RU-EG-PR	9	88.0	223	87.7	1:53
EG-RU-PR	6	79.0[g]	258	85.2	2:08
PR-EG-RU	7	86.0	238	78.3	2:05
RANDOM	8	90.4	207	88.0	1:35[h]

[a]Differences in Ns reflect missing data in computer printouts.

[b]Medium level.

[c]Significantly greater than EG-RU-PR and PR-EG-RU Groups.

[d]Significantly greater than other groups, but Cochran's C = .521, $p < .05$; PR-EG-RU Group variance significantly greater.

[e]Significantly longer than other three groups.

[f]Significantly smaller than combined RU-EG-PR and EG-RU-PR Groups.

[g]Significantly smaller than RU-EG-PR, but Cochran's C = .597, $p < .05$; EG-RU-PR Group variance significantly greater.

[h]Significantly shorter than other three groups.

Group (df = 1,29, MSW = 1164.0, F = 2.49, $p < .05$); but the difference was due to the poor performance of the PR-EG-RU Group, since the performance of the RANDOM Group did not differ significantly from that of the combined RU-EG-PR and EG-RU-PR Groups. On the Volts Lesson, the fixed-sequence groups spent significantly more time than the RANDOM Group (df = 1.26, MSW = 402.6, F = 10.86, $p < .01$). None of the other planned time comparisons was significant.

Questionnaire data are presented in Table 3 and indicate some dissatisfaction with CBI within the RU-EG-PR Group. Their replies to Question 5 (Enough graphics?) and Question 6 (Enough examples?) were considerably more negative than those of the other groups (df = 3, $\chi^2 = 11.96$, $p < .01$) as were their replies to Question 7 (Enough practice questions?) (df = 3, $\chi^2 = 9.73$, $p < .05$). The replies to Question 12 ("What proportion of your training would you like to see as CBI?") differed significantly among groups. The RU-EG-PR Group response mean was significantly lower than that of the other groups (df = 3,28, MSW = 715.5, F = 4.14, $p < .05$). The RU-EG-PR Group also made more negative comments; 4 out of 5 comments were negative, as compared to 0 of 5, 0 of 5, and 1 of 7 in the other groups (df = 3, $\chi^2 = 12.91$, $p < .01$). There were no other significant differences in the data. Only two persons in the RANDOM Group thought the lessons were poorly organized and that the procedures were troublesome. Considering the random presentation of the content, more students might have made this response.

Table 3

Questionnaire Results

Rating	RU-EG-PR	EG-RU-PR	PR-EG-RU	RANDOM
Lesson Rating:				
Good	8	7	8	10
Average	—	—	—	—
Poor	—	—	—	—
Content Rating:				
Easy	3	2	3	3
Average	5	5	4	7
Hard	—	—	1	—
Organization Rating:				
Well organized	8	7	8	8
Average	—	—	—	—
Poorly organized	—	—	—	2
1. Logical lesson sequence?*	Y-9, N-0	Y-6, N-1	Y-8, N-0	Y-10, N-0
2. Material difficult?	Y-1, N-8	Y-1, N-6	Y-1, N-7	Y-1, N-9
3. Explanations adequate?	Y-6, N-3	Y-6, N-1	Y-8, N-0	Y-10, N-0
4. Rules helpful?	Y-6, N-3	Y-7, N-0	Y-8, N-0	Y-9, N-1
5. Enough graphics?	Y-5, N-4	Y-7, N-0	Y-8, N-0	Y-10, N-0
6. Enough examples?	Y-5, N-4	Y-7, N-0	Y-8, N-0	Y-10, N-0
7. Enough practice?	Y-5, N-4	Y-6, N-1	Y-8, N-0	Y-10, N-0
8. Lessons difficult?	Y-1, N-8	Y-1, N-6	Y-0, N-8	Y-0, N-10
9. Enough time?	Y-9, N-0	Y-7, N-0	Y-8, N-0	Y-10, N-0
10. Adequate tests?	Y-8, N-1	Y-7, N-0	Y-8, N-0	Y-10, N-0
11. Procedures troublesome?	Y-1, N-7	Y-2, N-5	Y-2, N-6	Y-2, N-8
12. CBI preference (mean):	45%	91%	84%	78%
13. Comments	Generally Negative	Generally Favorable	Generally Favorable	One Negative Comment

*All questions are abbreviated for report presentation.

DISCUSSION

Lahey and Coady (1978) found no difference between subjects using a rule-example-practice strategy in a programmed mode and those using the same strategy in a learner control mode. Their data suggested a possible advantage for the student who usually chose the rule-example-practice strategy over those who more often chose other strategies. The current study finds no advantage in consistent use of the rule-example-practice strategy over the consistent use of an examples-rule-practice strategy or random use of a variety of available strategies. Together, these two studies suggest that if there is an advantage to the rule-examples-practice strategy, it is slight.

The three primary measures used--test score, number of responses, and time--are highly correlated, particularly in the Amps and Volts Lessons. The correlations between test score and time in the three lessons are -.57, -.33, and -.74, respectively; those between test score and total number of responses, -.57, -.17 (not significant), and -.83, respectively; and those between total responses and time, .76, .53, and 84, respectively. For both the Amps and Volts Lessons, the correlations are significant at the .01 level; for the Voltage Lessons, the test score vs. time correlation (-.33) is significant at the .05 level, and the total response number vs. time correlation (.53) is significant at the .01 level. The high correlation and the absence of consistent trends in the data confirm the assumption that no single strategy is superior.

An additional factor to be considered when analyzing the data is the ceiling effects in the Voltage and Volts Lessons. The indication that the PR-EG-RU and RANDOM Groups did not do well on the test scores for the Voltage Lesson must be weighed against the existence of the ceiling effect and the fact that these groups had generally higher scores, though not significantly so, in the Amps Lesson. In addition, the mean test score for these groups in the Volts Lesson was not significantly different from the mean test score for the RU-EG-PR Group.

Some difficulty with the PR-EG-RU strategy seems to have been demonstrated. Students using this strategy made more responses and spent more time on the Amps Lesson than did students using the other strategies. The PR-EG-RU Group consistently made more errors in all the lessons than did the other groups, although the differences were significant only in the Amps Lessons.

More than the other strategies, the PR-EG-RU strategy is a discovery strategy. The student must learn from his responses rather than from being told the rule, or by having it implied in a series of examples. Since discovery is not a usual teaching mode, it is not surprising that students do poorly when they first encounter it. What is surprising is that they pick up the technique well enough to perform comparably to the other groups in later lessons. On balance, however, it would appear that the PR-EG-RU strategy is the least effective of the strategies because it causes a greater number of errors in practice problems. Strategies such as this one may be less than optimal for efficient use of lesson time and should probably not be used for all students. Nevertheless, for those students who already understand the concept being presented, or for those who grasp it immediately, the option to select practice immediately can significantly reduce training time.

This study indicates that strategy has little effect on the student's performance. For instructional designers interested in using the learner control mode of CBI, this finding is encouraging. It means that giving the student control of the instructional sequence has no negative consequences and may offer technological advantages. For example, it facilitates lesson preparation (Hurlock & Slough, 1976) by eliminating the need to develop

elaborate branching strategies, since the student makes the branching decisions. Moreover, Merrill (1973) suggests that the learner control mode facilitates "learning to learn" and frees the student from the dependence on the teacher thus eliminating the need for sensitivity to aptitude-treatment interaction (Merrill, 1975). Hurlock and Slough (1976) note the possible economic advantage of lessons prepared in the format described by Lahey, Crawford, and Hurlock (1976).

CONCLUSIONS

On the basis of this study and the previous finding that learner control and programmed control are equivalent lesson presentation modes (Lahey & Coady, 1978), there appears to be no pedagogical disadvantage to using the learner control lesson presentation mode as proposed by Merrill (1973). There may also be no immediate pedagogical advantage, but there may be economic and technological advantages. Whether extended use will provide the long-term pedagogical advantages suggested by Merrill (1973) remains to be demonstrated.

RECOMMENDATIONS

Confirmation of these findings with other lesson materials and other student populations is desirable. Additional questions for future research are whether interactions between student characteristics and the instructional sequence result in significant differences (particularly, whether teacher-independent students do better under learner control conditions while others do better in a programmed control mode), and whether the cost savings indicated by Hurlock and Slough (1976) would be realized if all lessons were prepared in the learner control lesson mode. At least four avenues of research are suggested by the results of this and the previous study (Lahey & Coady, 1978):

1. Confirm that learner control is the equal of programmed control for the average learner.

2. Using other lesson materials, confirm that lesson performance is not significantly affected by the strategies a student might select.

3. Determine whether individual differences control the efficiency of the learner control and programmed control modes.

4. Compare the cost of developing CBI lesson materials using the learner control lesson structure with the costs associated with using other methods.

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